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QUALCOMM INCORPORATED
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EXAMINER	
WONG, LINDA	

ART UNIT	PAPER NUMBER
2611	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	**Application No.** 10/682,160	**Applicant(s)** KETCHUM ET AL.
	Examiner LINDA WONG	**Art Unit** 2611

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 July 2009*.
2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.
3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-37* is/are pending in the application.
 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5)☐ Claim(s) _____ is/are allowed.
6)☒ Claim(s) *1-27* is/are rejected.
7)☐ Claim(s) _____ is/are objected to.
8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.
10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a)☐ All b)☐ Some * c)☐ None of:
 1.☐ Certified copies of the priority documents have been received.
 2.☐ Certified copies of the priority documents have been received in Application No. _____.
 3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
 Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413)
 Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Response to Arguments

1. Applicant's arguments filed 7/23/2009 have been fully considered but they are not persuasive.

   a. Regarding **claims 1,7,11,15,19,26,30**, the applicant contends

> "In rejecting claim 1, the Examiner refers to FIG. 5 of *Ling* and notes multiple receive antennas, somehow concluding that *Ling* discloses "obtaining a plurality of received symbol streams for a plurality of data symbol streams sent via a plurality of spatial channels" because of the multiple receive antennas. However, the presence of multiple receive antennas does not mean that a plurality of data symbol streams are transmitted (i.e., receive diversity case with one transmitted symbol stream and two receive antennas)."

The examiner respectfully disagrees. Paragraph 8 of Ling discloses "Each of the Nc independent channels is also referred to as spatial subchannel of the MIMO channel and corresponds to a dimension." This indicates the plurality of receive channels shown in Fig. 1 are spatial channels.

The applicant further contends

> "Further, the claim recites that "spatial processing is performed at a transmitter with steering vectors, which are estimates of transmitter steering vectors required to orthogonalize the plurality of spatial channels..." However, *Ling* not teach performing spatial processing at a transmitter at all. Rather, *Ling* teaches various techniques for performing spatial processing at the receiver side."

The examiner respectfully disagrees. Paragraph 24 discloses "These transmit and receive antennas may be used to provide various forms of spatial diversity (i.e. antenna diversity), including transmit diversity and receive diversity. Spatial diversity is characterized by the use of multiple transmit antennas and one or more receive antennas. Transmit diversity is characterized by the transmission of data over multiple transmit antennas. Typically, additional processing is performed on data transmitted from the transmit antennas to achieve the desired diversity." Based on the paragraph above, spatial diversity processing is performed at the transmitter in order to achieve transmit diversity, which is a form of spatial diversity.

The applicant contends

> “While *Ling* does teach receiving orthogonal pilot transmissions, there is no teaching that "steering vectors are used at the transmitter to achieve orthogonality" among pilot transmissions. In fact, *Ling* does not teach at all about steering vectors/matrices and the word "steering" is not mentioned in this reference at all.”

The examiner respectfully disagrees. Paragraph 17 discloses the transmitter system uses OFDM, wherein OFDM inherently uses orthogonal codes. Paragraph 57 discloses "The modulation scheme employed for each of the modulation symbols is based on the effective SNR of that eigenmode and is proportional to an eigenvalue ..." this indicates steering vectors of eigenvectors are used for modulation or processing, wherein eigenvectors are well known in the art to provide orthogonality.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. **Claims 1-37** are rejected under 35 U.S.C. 102(e) as being anticipated by Ling et al (US Publication No.: 20030003880).

The applied reference has a common inventors and assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

a. **Claims 1,15**,

i. Ling et al discloses

- "obtaining a plurality of received symbol streams for a plurality of data symbol streams sent via a plurality of spatial channels of a MIMO channel in the wireless MIMO communication system" (Fig. 5, labels 152a-152r as the antennas for receiving a plurality of symbol streams via a plurality of spatial channels in a MIMO channel .)
- "wherein spatial processing is performed at a transmitter with steering vectors, which are estimates of transmitter steering vectors required to orthogonalize the plurality of spatial channels"; (paragraph 11 describes spatial time technique, wherein the transmitter receives channel state information from the receiver so to encode or modulate the transmit signal with spatial information.)

- “receiving orthogonal pilot transmissions from a plurality of antennas at the transmitter;” (Fig. 5, labels 152a-152r as the antennas for receiving a plurality of symbol streams via a plurality of spatial channels in a MIMO channel.)
- “obtaining an estimate of a channel response matrix for the MIMO channel, wherein the estimated channel response matrix is obtained based on the received orthogonal pilot transmissions;” (Fig. 5, label 522 channel estimator and paragraph 108 discloses the channel estimation is based on pilot information, wherein the pilot signal would be orthogonal since the system is OFDM.) and
- “performing spatial processing on the plurality of received symbol streams with a spatial filter to obtain a plurality of filtered symbol streams,” (paragraph 89-107 discloses the spatial techniques. Paragraphs 115-138 discloses spatial filtering using MMSE. Fig. 5, label 156a shows filtering within the spatial processing block.)
- “which are estimates of the plurality of data symbol streams, wherein the spatial filter has a response derived based on a minimum mean square error (MMSE) criterion that minimizes mean square error between the plurality of filtered symbol streams and the plurality of data symbol streams” (Paragraphs 115-138 discloses the MMSE process for determining error between the filtered symbols and the data symbol streams.),

- “wherein the MMSE criterion is given as min E [$(Wr - s)^H (Wr - s)$]” (paragraph 118 shows the cost function or the minimum MMSE estimate of x.)
- “where s is a vector for the plurality of data symbol streams,” (paragraph 118, x represents the transmit symbols)
- “where r is a vector for the plurality of received symbol streams,” (paragraph 118, r represents the vector of data symbol streams.)
- “W is a matrix for the spatial filter,” (paragraph 118, M represents the coefficients for the filter. (paragraph 154))
- “$(Wr-s)^H$ denotes the Hermitian or the conjugate transpose of (Wr-s)” (paragraph 118 shows (Mr-s) is transposed in the equation.) and
- “E[x] is an expected value of x.” (paragraph 118 shows that the calculation for the cost function, wherein the cost would be the expected value of x.)

b. **Claims 2,16**, Ling et al discloses “scaling the plurality of filtered symbol streams to obtain a plurality of recovered symbol streams, which are normalized estimates of the plurality of data symbol streams.” (paragraph 123 shows the normalization of x. paragraph 129 also discloses the equation for normalized estimates of the plurality of data symbol streams.)

c. **Claim 3**, Ling et al discloses "s = Wr, wherein s is a vector for the plurality of filter symbol streams”. (paragraph 122 shows the MMSE estimate of x or s.)

d. **Claim 8**, Ling et al discloses

- “receiving a steered pilot via the plurality of spatial channels” (paragraph 11 disclose the transmit signals are processed using channel state information determined from spatial processing performed in the receiver.) and
- “deriving the spatial filter response based on the received steered pilot.” (paragraph 96 discloses determining the channel coefficient matrix based on the pilot symbols.)

e. **Claim 9**, Ling et al discloses “the plurality of data symbol streams are spatially processed at the transmitter with a plurality of steering vectors obtained by decomposing an estimate of a channel response matrix for the MIMO channel.” (Fig. 5, label channel estimator determines the steering vectors and label 514 filters the received symbols with the vectors. Paragraph 8 discloses decomposing the data into independent channels, wherein the channel response matrix would contain information for each of the independent channels.)

f. **Claim 10**, Ling et al discloses “the MIMO system implements orthogonal frequency division multiplexing (OFDM), and wherein the spatial processing is performed for each of a plurality of subbands.” (Paragraph 5 discloses OFDM system, wherein spatial processing would be performed for each of the OFDM subbands or sub-carriers.)

g. **Claim 11**, Ling et al discloses

- “a receiver unit operative to receive orthogonal pilot transmissions from a plurality of antennas at a transmitter,” (Fig. 1, labels 124a-124t and 152a-152r show the antennas.)
- “the receiver unit also operative to obtain a plurality of received symbol streams for a plurality of data symbol streams sent via a plurality of spatial channels of a MIMO channel in the wireless MIMO communication system,” (Fig. 5, labels 152a-152r as the antennas for receiving a plurality of symbol streams via a plurality of spatial channels in a MIMO channel .)
- “wherein spatial processing is performed at a transmitter with steering vectors, which are estimates of transmitter steering vectors required to orthogonalize the plurality of spatial channels;” (paragraph 11 describes spatial time technique, wherein the transmitter receives channel state information from the receiver so to encode or modulate the transmit signal with spatial information.)
- “a channel estimator operative to obtain an estimate of a channel response matrix for the MIMO channel, wherein the estimated channel response matrix is obtained based on the received orthogonal pilot transmissions;” (Fig. 5, label 522 channel estimator and paragraph 108 discloses the channel estimation is based on pilot information, wherein the pilot signal would be orthogonal since the system is OFDM.) and,
- “a spatial filter operative to spatially process the plurality of received symbol streams to obtain a plurality of filtered symbol streams, which are estimates

of the plurality of data symbol streams," (paragraph 89-107 discloses the spatial techniques. Paragraphs 115-138 discloses spatial filtering using MMSE. Fig. 5, label 156a shows filtering within the spatial processing block.)

- "wherein the spatial filter has a response derived based on a minimum mean square error (MMSE) criterion that minimizes mean square error between the plurality of filtered symbol streams and the plurality of data symbol streams," (Paragraphs 115-138 discloses the MMSE process for determining error between the filtered symbols and the data symbol streams.)
- "wherein the MMSE criterion is given as: min E $[(Wr - s)^H (Wr - s)]$" (paragraph 118 shows the cost function or the minimum MMSE estimate of x.)
- "where s is a vector for the plurality of data symbol streams" (paragraph 118, x represents the transmit symbols)
- "where r is a vector for the plurality of received symbol streams" (paragraph 118, r represents the vector of data symbol streams.)
- "W is a matrix for the spatial filter" (paragraph 118, M represents the coefficients for the filter. (paragraph 154))
- "$(Wr\_-s)^H$ denotes the Hermitian or the conjugate transpose of (Wr- s)," (paragraph 118 shows (Mr-s) is transposed in the equation.) and

- "E[x] is an expected value of x." (paragraph 118 shows that the calculation for the cost function, wherein the cost would be the expected value of x.)

h. **Claims 12,16**, Ling et al discloses "a scaling unit operative to scale the plurality of filtered symbol streams to obtain a plurality of recovered symbol streams, which are normalized estimates of the plurality of data symbol streams." (paragraph 128 shows the normalization of x. paragraph 129 also discloses the equation for normalized estimates of the plurality of data symbol streams.)

i. **Claim 14**, Ling et al discloses "wherein the wireless MIMO communication system implements orthogonal frequency division multiplexing (OFDM), and wherein the spatial filter is operative to perform spatial processing for each of a plurality of subbands." (Paragraph 5 discloses OFDM system, wherein spatial processing would be performed for each of the OFDM subbands or sub-carriers.)

j. **Claim 18**, Ling et al discloses "wherein the wireless MIMO communication system implements orthogonal frequency division multiplexing (OFDM), and wherein the spatial processing is performed for each of a plurality of subbands." (Paragraph 5 discloses OFDM system, wherein spatial processing would be performed for each of the OFDM subbands or sub-carriers.)

k. **Claim 19**, Ling et al discloses

- "obtaining a plurality of data symbol streams for transmission on a plurality of spatial channels of a MIMO channel in the wireless MIMO communication system;" (Fig. 5, labels 152a-152r as the antennas for receiving a plurality of symbol streams via a plurality of spatial channels in a MIMO channel.)

- “obtaining an estimate of a plurality of steering vectors, wherein the plurality of steering vectors is based on received orthogonal pilot transmissions;” (Fig. 5, label 522 channel estimator and paragraph 108 discloses the channel estimation is based on pilot information, wherein the pilot signal would be orthogonal since the system is OFDM.) and
- “performing spatial processing on the plurality of data symbol streams with the plurality of steering vectors, one steering vector for each data symbol stream, to obtain a plurality of transmit symbol streams for transmission from a plurality of transmit antennas,” (Fig. 3, label 120c shows the processor, wherein the CSI is used for each data symbol stream.)
- “wherein the plurality of steering vectors are estimates of transmitter steering vectors required to orthogonalize the plurality of spatial channels,” (paragraph 5 discloses using OFDM wherein orthogonalization of the plurality of spatial channels would be performed as shown in Fig .3.) and
- “wherein the spatial filter has a response derived based on a minimum mean square error (MMSE) criterion that minimizes mean square error between the plurality of filtered symbol streams and the plurality of data symbol streams”, (Paragraphs 115-138 discloses the MMSE process for determining error between the filtered symbols and the data symbol streams.)

- “wherein the MMSE criterion is given as: min E [(Wr - s)^H (Wr - s)]” (paragraph 118 shows the cost function or the minimum MMSE estimate of x.)
- “where s is a vector for the plurality of data symbol streams” (paragraph 118, x represents the transmit symbols)
- “where r is a vector for the plurality of received symbol streams” (paragraph 118, r represents the vector of data symbol streams.)
- “W is a matrix for the spatial filter” (paragraph 118, M represents the coefficients for the filter. (paragraph 154))
- “(Wr_-s)^H denotes the Hermitian or the conjugate transpose of (Wr- s)”, (paragraph 118 shows (Mr-s) is transposed in the equation.) and
- “E[x] is an expected value of x.” (paragraph 118 shows that the calculation for the cost function, wherein the cost would be the expected value of x.)

l. **Claim 21**, Ling et al discloses “wherein the plurality of steering vectors are obtained by decomposing an estimate of a channel response matrix for the MIMO channel.” (fig. 5, label channel estimator determines the steering vectors and label 514 filters the received symbols with the vectors. Paragraph 8 discloses decomposing the data into independent channels, wherein the channel response matrix would contain information for each of the independent channels.)

m. **Claim 22**, Ling et al discloses

- “wherein the wireless MIMO communication system is a time division duplex (TDD) system” (paragraph 40 discloses time division multiplexing, wherein time division duplex is a type of TDM.),
- “wherein the plurality of data symbol streams are transmitted on a first link of the MIMO channel” (Fig. 5, label 152a receives the plurality of data symbol streams on a first link.) and
- “wherein the plurality of steering vectors are derived based on an estimate of a second link of the MIMO channel.” (Fig. 5, label 522 determines the channel estimation for the steering vectors based on all the received signal, wherein the received signals are received from multiple links.)

n. **Claim 23**, Ling et al discloses

- “obtaining an estimate of a channel response matrix for the second link;” (Fig. 5, label channel estimator determines the steering vectors and label 514 filters the received symbols with the vectors.)
- "decomposing the estimated channel response matrix for the second link to obtain the plurality of steering vectors used for the first link.” (Fig. 5, label channel estimator determines the steering vectors and label 514 filters the received symbols with the vectors. Paragraph 8 discloses decomposing the data into independent channels, wherein the channel response matrix would contain information for each of the independent channels.)

o. **Claim 24**, Ling et al discloses

- “receiving a steered pilot via a plurality of spatial channels of the second link;” (paragraph 11 disclose the transmit signals are processed using channel state information determined from spatial processing performed in the receiver.) and
- “deriving the plurality of steering vectors used for the first link based on the received
  steered pilot.” (paragraph 96 discloses determining the channel coefficient matrix based on the pilot symbols.)

p. **Claim 25**, Ling et al discloses “the MIMO system implements orthogonal frequency division multiplexing (OFDM), and wherein the spatial processing is performed for each of a plurality of subbands.” (Paragraph 5 discloses OFDM system, wherein spatial processing would be performed for each of the OFDM subbands or sub-carriers.)

q. **Claim 26**, Ling et al discloses

- “a transmit data processor operative to process a plurality of data streams” (Fig. 2a, label 110a shows the transmit data processor to process a plurality of data streams, label information bits) and
- “provide a plurality of data symbol streams for transmission on a plurality of spatial channels of a MIMO channel in the wireless MIMO communication system” (Fig. 2a, label information bits as the plurality of data symbol streams for transmission, labels 524a-424t are the plurality of spatial channels of a MIMO wireless communication system.)

- “an estimator operative to obtain an estimate of a plurality of steering vectors” (Fig. 3, label 312a-312l determines the plurality of steering vectors.)
- “wherein the plurality of steering vectors is based on received orthogonal pilot transmissions” (paragraph 48 discloses the CSI is reported by the receiver system, wherein the receiver uses training signals to determine the CSI. (Fig. 5, label 522)) and
- “a transmit spatial processor operative to perform spatial processing on the plurality of data symbol streams with the plurality of steering vectors, one steering vector for each data symbol stream, to obtain a plurality of transmit symbol streams for transmission from a plurality of transmit antennas” (Fig. 3, label 120c shows the processor, wherein the CSI is used for each data symbol stream.)
- “wherein the plurality of steering vectors are estimates of transmitter steering vectors required to orthogonalize the plurality of spatial channels” (paragraph 5 discloses using OFDM wherein orthogonalization of the plurality of spatial channels would be performed as shown in Fig .3.) and
- “wherein the plurality of data symbol streams are recovered at a receiver” (Fig. 5 shows the plurality of data symbol streams are recovered.) “with a spatial filter has a response derived based on a minimum mean square error (MMSE) criterion that minimizes mean square error between the plurality of filtered symbol streams and the plurality of data symbol streams”

(Paragraphs 115-138 discloses the MMSE process for determining error between the filtered symbols and the data symbol streams.),

- “wherein the MMSE criterion is given as min E $[(Wr - s)^H (Wr - s)]$” (paragraph 118 shows the cost function or the minimum MMSE estimate of x.)
- “where s is a vector for the plurality of data symbol streams,” (paragraph 118, x represents the transmit symbols)
- “where r is a vector for the plurality of received symbol streams,” (paragraph 118, r represents the vector of data symbol streams.)
- “W is a matrix for the spatial filter,” (paragraph 118, M represents the coefficients for the filter. (paragraph 154))
- “$(Wr-s)^H$ denotes the Hermitian or the conjugate transpose of (Wr-s)” (paragraph 118 shows (Mr-s) is transposed in the equation.) and
- “E[x] is an expected value of x.” (paragraph 118 shows that the calculation for the cost function, wherein the cost would be the expected value of x.)

r. **Claim 27**, Ling et al discloses

- "the wireless MIMO communication system is a time division duplex (TDD) system” (paragraph 40 discloses time division multiplexing, wherein time division duplex is a type of TDM.),
- “wherein the plurality of data symbol streams are transmitted on a first link of the MIMO channel” (Fig. 5, label 152a receives the plurality of data symbol streams on a first link.) and

- “wherein the plurality of steering vectors are derived based on an estimate of a second link of the MIMO channel.” (Fig. 5, label 522 determines the channel estimation for the steering vectors based on all the received signal, wherein the received signals are received from multiple links.)

s. **Claim 28**, Ling et al discloses

- “a channel estimator operative to obtain an estimate of a channel response matrix for the second link;” (Fig. 5, label channel estimator determines the steering vectors and label 514 filters the received symbols with the vectors.) and
- “a matrix computation unit operative to decompose the estimated channel response matrix

  to obtain the plurality of steering vectors used for the first link.” (Fig. 5, label channel estimator determines the steering vectors and label 514 filters the received symbols with the vectors. Paragraph 8 discloses decomposing the data into independent channels, wherein the channel response matrix would contain information for each of the independent channels.)

t. **Claim 29**, Ling et al discloses

- “a channel estimator operative to obtain a channel response estimate for a plurality of spatial channels of the second link” (Fig. 5, label channel estimator determines the steering vectors and label 514 filters the received symbols with the vectors.) “based on a steered pilot received via the plurality of spatial channels of the second link” (paragraph 75 discloses the

CSI is determined based on the report from the receiver and Fig. 5 shows the plurality of data streams are used to determined the channel estimate or CSI.) and

- “wherein the plurality of steering vectors used for the first link are derived based on the channel response estimate for the plurality of spatial channels of the second link.” (Fig. 5, label channel estimator determines the steering vectors and label 514 filters the received symbols with the vectors. Paragraph 8 discloses decomposing the data into independent channels, wherein the channel response matrix would contain information for each of the independent channels.)

u. **Claim 30**, Ling et al discloses

- “means for obtaining a plurality of data symbol streams for transmission on a plurality of spatial channels of a MIMO channel in the wireless MIMO communication system” (Fig. 2a, label 110a shows the transmit data processor to process a plurality of data streams, label information bits. Fig. 2a, label information bits as the plurality of data symbol streams for transmission, labels 524a-424t are the plurality of spatial channels of a MIMO wireless communication system.)
- “means for obtaining an estimate of a plurality of steering vectors,” (Fig. 3, label 312a-312l determines the plurality of steering vectors.)
- “wherein the plurality of steering vectors is based on received orthogonal pilot transmissions;” (paragraph 48 discloses the CSI is reported by the

receiver system, wherein the receiver uses training signals to determine the CSI. (Fig. 5, label 522)) and

- “means for performing spatial processing on the plurality of data symbol streams with the plurality of steering vectors, one steering vector for each data symbol stream, to obtain a plurality of transmit symbol streams for transmission from a plurality of transmit antennas,” (Fig. 3, label 120c shows the processor, wherein the CSI is used for each data symbol stream.)
- “wherein the plurality of steering vectors are estimates of transmitter steering vectors required to orthogonalize the plurality of spatial channels,” (paragraph 5 discloses using OFDM wherein orthogonalization of the plurality of spatial channels would be performed as shown in Fig .3.) and
- “wherein the plurality of data symbol streams are recovered at a receiver” (Fig. 5 shows the plurality of data symbol streams are recovered.) “with a spatial filter has a response derived based on a minimum mean square error (MMSE) criterion that minimizes mean square error between the plurality of filtered symbol streams and the plurality of data symbol streams” (Paragraphs 115-138 discloses the MMSE process for determining error between the filtered symbols and the data symbol streams.),
- “wherein the MMSE criterion is given as min E $[(Wr - s)^H (Wr - s)]$” (paragraph 118 shows the cost function or the minimum MMSE estimate of x.)

- “where s is a vector for the plurality of data symbol streams,” (paragraph 118, x represents the transmit symbols)
- “where r is a vector for the plurality of received symbol streams,” (paragraph 118, r represents the vector of data symbol streams.)
- “W is a matrix for the spatial filter,” (paragraph 118, M represents the coefficients for the filter. (paragraph 154))
- “$(Wr\text{-}s)^H$ denotes the Hermitian or the conjugate transpose of (Wr-s)” (paragraph 118 shows (Mr-s) is transposed in the equation.) and
- “E[x] is an expected value of x.” (paragraph 118 shows that the calculation for the cost function, wherein the cost would be the expected value of x.)

v. **Claim 31**, Ling et al discloses

- "the wireless MIMO communication system is a time division duplex (TDD) system” (paragraph 40 discloses time division multiplexing, wherein time division duplex is a type of TDM.)
- “wherein the plurality of data symbol streams are transmitted on a first link of the MIMO channel,” (Fig. 5, label 152a receives the plurality of data symbol streams on a first link.) and
- “wherein the plurality of steering vectors are derived based on an estimate of a second link of the MIMO channel.” (Fig. 5, label 522 determines the channel estimation for the steering vectors based on all the received signal, wherein the received signals are received from multiple links.)

w. **Claim 32**, Ling et al discloses

- “means for obtaining an estimate of a channel response matrix for the second link;” (Fig. 5, label channel estimator determines the steering vectors and label 514 filters the received symbols with the vectors.) and
- “means for decomposing the estimated channel response matrix for the second link to obtain the plurality of steering vectors used for the first link.” (Fig. 5, label channel estimator determines the steering vectors and label 514 filters the received symbols with the vectors. Paragraph 8 discloses decomposing the data into independent channels, wherein the channel response matrix would contain information for each of the independent channels.)

x. **Claim 33**, Ling et al discloses

- “means for receiving a steered pilot via a plurality of spatial channels of the second link;” (paragraph 11 disclose the transmit signals are processed using channel state information determined from spatial processing performed in the receiver.) and
- “means for deriving the plurality of steering vectors used for the first link based on the received steered pilot.” (paragraph 96 discloses determining the channel coefficient matrix based on the pilot symbols.)

y. **Claim 34,** Ling et al discloses "the wireless MIMO communication system implements orthogonal frequency division multiplexing (OFDM), and wherein the spatial processing is performed for each of a plurality of subbands.”

(Paragraph 5 discloses OFDM system, wherein spatial processing would be performed for each of the OFDM subbands or sub-carriers.)

z. **Claim 35**, Ling et al discloses “deriving the spatial filter response based on the estimated channel response matrix.” (Fig. 3, label CSI as the channel state information, label 312a as the processor or filter.)

aa. **Claim 36**, Ling et al discloses “a matrix computation unit operative to derive the spatial filter response based on the estimated channel response matrix.” (Fig. 3, label CSI as the channel state information, label 312a as the processor or filter.)

bb. **Claim 37**, Ling et al discloses “means for deriving the spatial filter response based on the estimated channel response matrix.” (Fig. 3, label CSI as the channel state information, label 312a as the processor or filter.)

Conclusion

3. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.
   a. US Publication No.: 20030185310
   b. US Publication No.: 20030108117.
4. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).
5. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LINDA WONG whose telephone number is (571)272-6044. The examiner can normally be reached on 9-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shuwang Liu can be reached on (571) 272-3036. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Linda Wong
8/30/2009
/Shuwang Liu/
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